



## TRANSMITTAL OF APPEAL BRIEF

Docket No.  
SON-2363

In re Application of: Toshihiko Senno et al.

Application No. 10/067,347-Conf. #4610	Filing Date February 7, 2002	Examiner S. H. Pak	Group Art Unit 2874
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Invention: OPTICAL COUPLING DEVICE

### TO THE COMMISSIONER OF PATENTS:

Transmitted herewith in triplicate is the Appeal Brief in this application, with respect to the Notice of Appeal filed: March 17, 2004.

The fee for filing this Appeal Brief is 330.00.

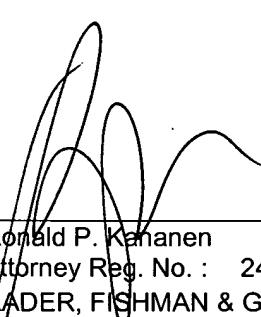
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Dated: April 2, 2004



Docket No.: SON-2363  
(80001-2363)

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re Patent Application of:  
Toshihiko Senno et al.

Application No.: 10/067,347

Confirmation No.: 4610

Filed: February 7, 2002

Art Unit: 2874

For: OPTICAL COUPLING DEVICE

Examiner: S. H. Pak

**APPELLANT'S BRIEF**

MS Appeal Brief - Patents  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Dear Sir:

This is an Appeal Brief under Rule 192 appealing the final decision of the Examiner dated December 17, 2003. Each of the topics required by Rule 192 is presented herewith and is labeled appropriately.

This brief is in furtherance of the Notice of Appeal, filed in this case on March 17, 2004.

This brief is transmitted in triplicate.

This brief contains items under the following headings as required by 37 C.F.R. § 1.192 and M.P.E.P. § 1206:

- I. Real Party In Interest
- II. Related Appeals and Interferences
- III. Status of Claims
- IV. Status of Amendments
- V. Summary of Invention

- VI. Issues
- VII. Grouping of Claims
- VIII. Arguments
- IX. Claims Involved in the Appeal

Appendix A Claims

I. REAL PARTY IN INTEREST

Sony Corporation of Tokyo, Japan ("Sony") is the real party in interest of the present application. An assignment of all rights in the present application to Sony was executed by the inventor and recorded by the U.S. Patent and Trademark Office at **reel 012806, frame 0842**.

II. RELATED APPEALS AND INTERFERENCES

There are no other appeals or interferences which will directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

III. STATUS OF CLAIMS

A. Total Number of Claims in Application

There are 30 claims pending in application.

**B. Current Status of Claims**

1. Claims canceled: 1-49
2. Claims withdrawn from consideration but not canceled: none
3. Claims pending: 50-79
4. Claims allowed: none
5. Claims rejected: none

**C. Claims On Appeal**

The claims on appeal are claims 50-79

**IV. STATUS OF AMENDMENTS**

Subsequent to the final rejection of December 17, 2003, an Amendment After Final Action (37 CFR Section 1.116) has been filed along with the Appeal Brief for the purpose of correcting a typographical error within claim 65.

**V. SUMMARY OF INVENTION**

The present invention relates to an optical coupling device, and particularly to an optical coupling device for coupling light, which has gone out of a light outgoing member, to a light incoming member by means of an optical lens.

The optical lens array includes a lens substrate 10 made from an optical material and having a plurality of convex portions 11 extending therefrom, wherein a convex portion 11 of the plurality of convex portions 11 has a convex shape and comprises a material the same as that of said lens

substrate (figure 3D). The lens substrate 10 has a mask layer MS on the surface thereof, wherein the mask layer MS comprises a material different than that of the lens substrate (figure 3A). A height of the convex portion 11 is specified on the basis of a thickness of the mask layer (figures 3C, 3D and page 27, line 14 to page 28, line 7).

## VI. ISSUES

The issues presented for consideration in this appeal are as follows:

Whether the Examiner erred in rejecting claims 50-64 under 35 U.S.C. §102 as being allegedly anticipated by U.S. Patent No. 6,434,297 to Althaus et al. (Althaus).

Whether the Examiner erred in rejecting claims 65-79 under 35 U.S.C. §103 as being allegedly obvious over Althaus in view of U.S. Patent No. 5,768,456 to Knapp et al. (Knapp).

These issues will be discussed hereinbelow.

## VII. GROUPING OF CLAIMS

For purposes of this appeal brief only, and without conceding the teachings of any prior art reference, the claims have been grouped as indicated below.

### Claim Groups:

Claims 50, 53-54, 56-57, 59-63 stand or fall together.

Claim 51 stands or falls separately.

Claim 52 stands or falls separately.

Claim 55 stands or falls separately.

Claim 58 stands or falls separately.

Claim 64 stands or falls separately.

Claim 65-68, 70-72, 74-77 stand or fall together.

Claim 69 stands or falls separately.

Claim 73 stands or falls separately.

Claim 78 stands or falls separately.

Claim 79 stands or falls separately.

In Section VIII below, Applicant has included arguments supporting the separate patentability of each claim group as required by M.P.E.P. § 1206.

## VIII. ARGUMENTS

In the Office Action of December 17, 2003:

The Examiner rejected claims 50-64 under 35 U.S.C. §102 as being allegedly anticipated by Althaus.

The Examiner rejected claims 65-79 under 35 U.S.C. §103 as being allegedly obvious over Althaus in view of Knapp.

For at least the following reasons, Appellant submits that these rejections are both technically and legally unsound and should therefore be reversed.

### General Matters

M.P.E.P. 707.07(f) states that “the importance of answering such arguments is illustrated by *In re Herrmann*, 261 F.2d 598, 120 USPQ 182 (CCPA 1958) where the applicant urged that the

subject matter claimed produced new and useful results. The court noted that since applicant's statement of advantages was not questioned by the examiner or the Board of Appeals, it was constrained to accept the statement at face value and therefore found certain claims to be allowable. See also *In re Soni*, 54 F.3d 746, 751, 34 USPQ2d 1684, 1688 (Fed Cir. 1995) (Office failed to rebut applicant's argument)."

**The Examiner erred in rejecting claims 50-64 under 35 U.S.C. §102 as being allegedly anticipated by Althaus.**

"A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987).

**Claims 50, 53-54, 56-57, and 59-63**

This rejection is traversed at least for the following reasons.

Claim 50 and the claims dependent thereon are drawn to an optical coupling device comprising:

an optical lens array including a lens substrate made from an optical material and having a plurality of convex portions extending therefrom, a convex portion of said plurality of convex portions having a convex shape and comprising a material the same as that of said lens substrate,

said lens substrate having a mask layer on the surface thereof, said mask layer comprising a material different than that of said lens substrate,

a height of said convex portion being specified on the basis of a thickness of said mask layer.

Within claim 50 and the claims dependent thereon, a convex portion has a convex shape and comprises a material the same as that of the lens substrate, wherein a height of the convex portion is specified on the basis of a thickness of the mask layer. Support for the claims is provided, at least, within figures 3A-3D and their associated disclosure within the specification as originally filed.

Althaus arguably teaches an optical system having a lens substrate 2 and a convex portion 7 (figures 1-2). Althaus arguably teaches a mask layer 13 (figure 3). Nevertheless, Althaus fails to disclose, teach or suggest the height of a convex portion 11 being specified on the basis of a thickness of the mask layer 13.

The Final Office Action contends that the overall height of the convex portion 11 of Althaus is dependent upon the height of mask layer 13 that has been patterned into diaphragms 4. The Final Office Action further contends that Althaus, read broadly, discloses the height of the convex portion being specified on the basis of a thickness of a mask layer. That is, the thickness of a mask layer contributes and determines the overall height of the resulting convex portion of the lens substrate (figure 3). The thicker the mask layer, the greater the height of the convex portion.

In response to these contentions, substrate 10 of Althaus is arguably a silicon semiconductor wafer (column 4, line 10) and mask layer 13 is arguably of a metal (column 4, line 24), whereas the claimed invention provides that a convex portion comprises a material the same as that of the lens substrate. Thus the metal mask layer 13 of Althaus is separate and distinct from the convex portion 11.

Moreover, while Althaus arguably teaches a step of producing a plurality of convex projections 11 on a first main surface 12 of the silicon wafer 10 by means of a photographic technique and etching (column 4, lines 21-23), Althaus fails to disclose, teach or suggest the particular details of how the plurality of convex projections 11 are produced. While Althaus arguably teaches the steps of applying a metal layer 13 to the entire first main surface 12 (column 4,

lines 24-25) and structuring the metal layer by means of a photographic technique and etching in such a manner that a diaphragm 4 remains on each convex projection 11 (column 4, lines 26-29), Althaus fails to disclose, teach or suggest a use of the metal layer 13 as an etch mask.

The Advisory Action of February 24, 2004 contends that the height of the mask layer disposed on the convex portion of the lens substrate determines the overall height of the convex portion of the lens substrate in the Althaus reference.

In response to this contention, figure 3 of Althaus depicts the formation of the convex portion 11 prior to the deposition of the mask layer 13 onto the convex portion 11. Mask layer 13 is formed after the formation of the convex portions 11. Althaus fails to disclose, teach or suggest the height of a convex portion 11 being specified on the basis of a thickness of the mask layer 13.

**There is no contribution made by the mask layer 13 of Althaus to the formation of the convex portions 11.** Thus, Althaus fails to disclose, teach or suggest the mask layer 13 as contributing to the formation of convex portions 11. In this regard, the mask layer 13 is separate and distinct from the convex portions 11.

#### Claim 51

The rejection of this claim is traversed at least for the reasons with respect to claim 50 and for the following reasons.

Within claim 51, the curvature of said convex portion is specified on the basis of a diameter of said mask layer.

Althaus arguably depicts the formation of the mask layer 13 after the formation of the convex portions 11 (figure 3). Thus, Althaus fails to disclose, teach or suggest the curvature of convex portions 11 being specified on the basis of a diameter of the mask layer 13.

Moreover, Althaus fails to disclose, teach or suggest the mask layer 13 as having a diameter.

Claim 52

The rejection of this claim is traversed at least for the reasons with respect to claim 50 and for the following reasons.

Within claim 52, the curvature of said convex portion is specified on the basis of a thickness of said mask layer.

Althaus arguably depicts the formation of the mask layer 13 after the formation of the convex portions 11 (figure 3). Thus, Althaus fails to disclose, teach or suggest the curvature of convex portions 11 being specified on the basis of a thickness of the mask layer 13.

Claim 55

The rejection of this claim is traversed at least for the reasons with respect to claim 50 and for the following reasons.

Within claim 55, the mask layer is composed of a photoresist. However, Althaus fails to disclose, teach or suggest the metal layer 13 as composed of a photoresist. Instead, Althaus arguably teaches the metal layer 13 as composed of a metal (column 4, lines 24-25).

Claim 58

The rejection of this claim is traversed at least for the reasons with respect to claim 50 and for the following reasons.

Within claim 58, a mask layer portion of said plurality of mask layer portions and part of said lens substrate are simultaneously removed. However, Althaus fails to disclose, teach or suggest a mask layer portion 4 of plurality of mask layer portions 4 and part of the lens substrate 10 being simultaneously removed. Simultaneous removal is not found within Althaus.

Claim 64

The rejection of this claim is traversed at least for the reasons with respect to claim 50 and for the following reasons.

Within claim 64, a groove is formed in said lens substrate between said convex portion and another of said plurality of convex portions. However, Althaus fails to disclose, teach or suggest a groove formed in lens substrate 10 between the convex portion 11 and another of the plurality of convex portions 11.

*The Examiner erred in rejecting claims 65-79 under 35 U.S.C. §103 as being allegedly obvious over Althaus in view of Knapp.*

This rejection is traversed at least for the following reasons.

“The Patent and Trademark Office (PTO) has the burden of showing a prima facie case of obviousness.” *In re Bell*, 26 USPQ2d 1529, 1530 (Fed. Cir. 1993). “In determining the propriety of the Patent Office case for prima facie obviousness, it is necessary to ascertain whether the prior art teachings would appear to be sufficient to one of ordinary skill in the art to suggest making the proposed substitution or other modification.” *In re Taborsky*, 183 USPQ 50, 55 (CCPA 1974). Moreover, *prima facie* obviousness of a claimed invention is established “only by showing some objective teaching in the prior art or that knowledge generally available to one of ordinary skill in the art would lead that individual to combine the relevant teachings of the references.” *In re Fine*, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988).

Claim 65-68, 70-72, and 74-77

The rejection of this claim is traversed at least for the reasons with respect to claim 50 and for the following reasons.

Claim 65 and the claims dependent thereon are drawn to an optical coupling device further comprising:

a light outgoing member having an array of a plurality of light outgoing portions, a light outgoing portion of said a plurality of light outgoing portions emitting light; and

a light incoming member having a plurality of light incoming portions, a light incoming portion of said a plurality of light incoming portions receiving said light, said light incoming portion corresponding to said light outgoing portion,

wherein said optical lens array includes a plurality of optical lens portions, an optical lens portion of said plurality of optical lens portions corresponding to said light outgoing portion and said light incoming portion.

The Final Office Action admits that Althaus fails to disclose, teach or suggest the use of light emitting diode array and light receiving optical fiber arrays as recited within the claims, and cites Knapp for the features deficient within Althaus.

Knapp arguably teaches an optoelectronic package having convex portion 140 and lens substrate 142 (figure 4). But like Althaus, Knapp fails to disclose, teach or suggest the height of the convex portion 142 being specified on the basis of a thickness of a mask layer.

Claim 69

The rejection of this claim is traversed at least for the reasons with respect to claim 65 and for the following reasons.

Within claim 69, the plurality of optical fibers is arrayed in such a manner that outer peripheral portions of adjacent two of said plurality of optical fibers are in contact with each other. Support is provided within at least figures 13-15 of the specification as originally filed.

While Knapp arguably teaches a plurality of optical fibers 15, 115 (figures 2, 5), Knapp fails to disclose, teach or suggest the plurality of optical fibers 15, 115 being arrayed in such a manner that outer peripheral portions of adjacent two of the plurality of optical fibers 15, 115 are in contact with each other.

#### Claim 73

The rejection of this claim is traversed at least for the reasons with respect to claim 71 and for the following reasons.

Within claim 73, the plurality of optical fibers is arrayed in such a manner that outer peripheral portions of adjacent two of said plurality of optical fibers are in contact with each other. Support is provided within at least figures 13-15 of the specification as originally filed.

While Knapp arguably teaches a plurality of optical fibers 15, 115 (figures 2, 5), Knapp fails to disclose, teach or suggest the plurality of optical fibers 15, 115 being arrayed in such a manner that outer peripheral portions of adjacent two of the plurality of optical fibers 15, 115 are in contact with each other.

#### Claim 78

The rejection of this claim is traversed at least for the reasons with respect to claim 74 and for the following reasons.

Within claim 78, the plurality of optical fibers is arrayed in such a manner that outer peripheral portions of adjacent two of said plurality of optical fibers are in contact with each other. Support is provided within at least figures 13-15 of the specification as originally filed.

While Knapp arguably teaches a plurality of optical fibers 15, 115 (figures 2, 5), Knapp fails to disclose, teach or suggest the plurality of optical fibers 15, 115 being arrayed in such a manner that outer peripheral portions of adjacent two of the plurality of optical fibers 15, 115 are in contact with each other.

Claim 79

This rejection is traversed at least for the following reasons.

Claim 79 is drawn to an optical coupling device comprising:

a light outgoing member having an array of a plurality of light outgoing portions, a light outgoing portion of said a plurality of light outgoing portions emitting light;

a light incoming member having a plurality of light incoming portions, a light incoming portion of said a plurality of light incoming portions receiving said light, said light incoming portion corresponding to said light outgoing portion; and

an optical lens array including a lens substrate made from an optical material and having a plurality of convex portions extending therefrom, a convex portion of said plurality of convex portions having a convex shape and comprising a material the same as that of said lens substrate,

said lens substrate having a mask layer on the surface thereof, said mask layer having a plurality of mask layer portions and comprising a material different than that of said lens substrate, a mask layer portion of said plurality of mask layer portions has a curved surface, a location of said mask layer portion corresponding to a formation region of said convex portion,

said lens substrate being exposed between said mask layer portion and another of said plurality of mask layer portions,

a height and curvature of said convex portion being specified on the basis of a thickness of said mask layer.

Althaus arguably teaches an optical system having a lens substrate 2 and a convex portion 7 (figures 1-2). Althaus arguably teaches a mask layer 13 (figure 3). Nevertheless, Althaus fails to disclose, teach or suggest the height and curvature of a convex portion 11 being specified on the basis of a thickness of the mask layer 13.

The Final Office Action contends that the overall height of the convex portion 11 of Althaus is dependent upon the height of mask layer 13 that has been patterned into diaphragms 4. The Final Office Action further contends that Althaus, read broadly, discloses the height of the convex portion being specified on the basis of a thickness of a mask layer. That is, the thickness of a mask layer contributes and determines the overall height of the resulting convex portion of the lens substrate (figure 3). The thicker the mask layer, the greater the height of the convex portion.

In response to these contentions, substrate 10 of Althaus is arguably a silicon semiconductor wafer (column 4, line 10) and mask layer 13 is arguably of a metal (column 4, line 24), whereas the claimed invention provides that a convex portion comprises a material the same as that of the lens substrate. Thus the metal mask layer 13 of Althaus is separate and distinct from the convex portion 11.

Moreover, while Althaus arguably teaches a step of producing a plurality of convex projections 11 on a first main surface 12 of the silicon wafer 10 by means of a photographic technique and etching (column 4, lines 21-23), Althaus fails to disclose, teach or suggest the particular details of how the plurality of convex projections 11 are produced. While Althaus arguably teaches the steps of applying a metal layer 13 to the entire first main surface 12 (column 4,

lines 24-25) and structuring the metal layer by means of a photographic technique and etching in such a manner that a diaphragm 4 remains on each convex projection 11 (column 4, lines 26-29), Althaus fails to disclose, teach or suggest a use of the metal layer 13 as an etch mask.

The Advisory Action of February 24, 2004 contends that the height of the mask layer disposed on the convex portion of the lens substrate determines the overall height of the convex portion of the lens substrate in the Althaus reference.

In response to this contention, figure 3 of Althaus depicts the formation of the convex portion 11 prior to the deposition of the mask layer 13 onto the convex portion 11. Mask layer 13 is formed after the formation of the convex portions 11. Althaus fails to disclose, teach or suggest the height of a convex portion 11 being specified on the basis of a thickness of the mask layer 13.

**There is no contribution made by the mask layer 13 of Althaus to the formation of the convex portions 11.** Thus, Althaus fails to disclose, teach or suggest the mask layer 13 as contributing to the formation of convex portions 11. In this regard, the mask layer 13 is separate and distinct from the convex portions 11.

The Final Office Action admits that Althaus fails to disclose, teach or suggest the use of light emitting diode array and light receiving optical fiber arrays as recited within the claims, and cites Knapp for the features deficient within Althaus.

Knapp arguably teaches an optoelectronic package having convex portion 140 and lens substrate 142 (figure 4). But like Althaus, Knapp fails to disclose, teach or suggest the height of the convex portion 142 being specified on the basis of a thickness of a mask layer.

Conclusion

The Office Action fails to disclose, teach or suggest at least the above-noted features of the claimed invention at the time the invention was made, and therefore, does not anticipate Applicant's invention or render it obvious.

Thus, the claims are considered allowable for the same reasons discussed above, as well as for the additional features they recite.

Reversal of the Examiner's decision is respectfully requested.

**IX. CLAIMS INVOLVED IN THE APPEAL**

A copy of the claims involved in the present appeal is attached hereto as Appendix A.

If any fee is required or any overpayment made, the Commissioner is hereby authorized to charge the fee or credit the overpayment to Deposit Account # 18-0013.

Dated: April 2, 2004

Respectfully submitted,

By \_\_\_\_\_

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## APPENDIX A

50. An optical coupling device comprising:

an optical lens array including a lens substrate made from an optical material and having a plurality of convex portions extending therefrom, a convex portion of said plurality of convex portions having a convex shape and comprising a material the same as that of said lens substrate,

said lens substrate having a mask layer on the surface thereof, said mask layer comprising a material different than that of said lens substrate,

a height of said convex portion being specified on the basis of a thickness of said mask layer.

51. An optical coupling device according to claim 50, wherein the curvature of said convex portion is specified on the basis of a diameter of said mask layer.

52. An optical coupling device according to claim 50, wherein the curvature of said convex portion is specified on the basis of a thickness of said mask layer.

53. An optical coupling device according to claim 50, wherein said plurality of convex portions are arrayed on said lens substrate.

54. An optical coupling device according to claim 50, wherein said optical material includes quartz or silicon oxide.

55. An optical coupling device according to claim 50, wherein said mask layer is composed of a photoresist.

56. An optical coupling device according to claim 50, wherein a convex portion of said plurality of convex portions is an optical lens portion of a plurality of optical lens portions.

57. An optical coupling device according to claim 50, wherein said mask layer comprises a plurality of mask layer portions.

58. An optical coupling device according to claim 57, wherein a mask layer portion of said plurality of mask layer portions and part of said lens substrate are simultaneously removed.

59. An optical coupling device according to claim 57, wherein a mask layer portion of said plurality of mask layer portions is separate and distinct from another of said plurality of mask layer portions.

60. An optical coupling device according to claim 57, wherein said lens substrate is exposed between said mask layer portion and another of said plurality of mask layer portions.

61. An optical coupling device according to claim 57, wherein a mask layer portion of said plurality of mask layer portions has a curved surface.

62. An optical coupling device according to claim 57, wherein a location of a mask layer portion of said plurality of mask layer portions correspond to a formation region of said convex portion.

63. An optical coupling device according to claim 50, wherein a light absorber having apertures is formed on said lens substrate.

64. An optical coupling device according to claim 50, wherein a groove is formed in said lens substrate between said convex portion and another of said plurality of convex portions.

65. An optical coupling device according to claim 50, further comprising:  
a light outgoing member having an array of a plurality of light outgoing portions, a light outgoing portion of said a plurality of light outgoing portions emitting light; and

a light incoming member having a plurality of light incoming portions, a light incoming portion of said a plurality of light incoming portions receiving said light, said light incoming portion corresponding to said light outgoing portion,

wherein said optical lens array includes a plurality of optical lens portions, an optical lens portion of said plurality of optical lens portions corresponding to said light outgoing portion and said light incoming portion.

66. An optical coupling device according to claim 65, wherein said light outgoing member is a light emitting device array having an array of a plurality of light emitting portions.

67. An optical coupling device according to claim 66, wherein said light emitting device array is a light emitting diode array.

68. An optical coupling device according to claim 65, wherein said light incoming member is an array of a plurality of optical fibers.

69. An optical coupling device according to claim 68, wherein said plurality of optical fibers is arrayed in such a manner that outer peripheral portions of adjacent two of said plurality of optical fibers are in contact with each other.

70. An optical coupling device according to claim 65, wherein said light outgoing member is an array of a plurality of optical fibers.

71. An optical coupling device according to claim 65, wherein said light incoming member is a light receiving device array having an array of a plurality of light receiving portions.

72. An optical coupling device according to claim 71, wherein said light receiving device array is formed by arraying said light receiving portions on a light receiving device substrate.

73. An optical coupling device according to claim 71, wherein said optical fibers are arrayed in such a manner that outer peripheral portions thereof are in contact with each other.

74. An optical coupling device according to claim 71, wherein said light receiving device array is a photodiode array.

75. An optical coupling device according to claim 65, wherein part of each of said light incoming member and said light outgoing member is an array of a plurality of optical fibers.

76. An optical coupling device according to claim 74, wherein the rest of said light outgoing member is a light emitting device array having an array of a plurality of light emitting portions, and the rest of said light incoming member is a light receiving device array having an array of a plurality of light receiving portions.

77. An optical coupling device according to claim 74, wherein said light emitting portions of said light emitting device array as the rest of said light outgoing member and said light receiving portions of said light receiving device array as the rest of said light incoming member are arrayed on the same device substrate.

78. An optical coupling device according to claim 74, wherein said optical fibers are arrayed in such a manner that outer peripheral portions thereof are in contact with each other.

79. An optical coupling device comprising:

a light outgoing member having an array of a plurality of light outgoing portions, a light outgoing portion of said a plurality of light outgoing portions emitting light;

a light incoming member having a plurality of light incoming portions, a light incoming portion of said a plurality of light incoming portions receiving said light, said light incoming portion corresponding to said light outgoing portion; and

an optical lens array including a lens substrate made from an optical material and having a plurality of convex portions extending therefrom, a convex portion of said plurality of convex portions having a convex shape and comprising a material the same as that of said lens substrate,

said lens substrate having a mask layer on the surface thereof, said mask layer having a plurality of mask layer portions and comprising a material different than that of said lens substrate, a mask layer portion of said plurality of mask layer portions has a curved surface, a location of said mask layer portion corresponding to a formation region of said convex portion,

said lens substrate being exposed between said mask layer portion and another of said plurality of mask layer portions,

a height and curvature of said convex portion being specified on the basis of a thickness of said mask layer.